DOE FTD Workshop
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Statement – Shell International Gas, London

<u>Definition of natural gas-based fuels and FTD</u>

FT processes divide into

- Low temperature Fischer Tropsch
- High temperature Fischer Tropsch or "FT/COD"

The products made by these processes are substantially different. The former make products that are primarily paraffinic, with very high cetane number and significant emissions benefits in diesel engines. The latter make a diesel fraction that contains significant proportions of aromatics and which resemble standard diesel more closely [e.g. in terms of cetane number, aromatics and density]. Shell has no experience measuring the emissions performance of diesel produced from the FT/COD process, but based on its more conventional composition [and available emissions models] would not expect this product to show the same level of emissions benefits as a "low temperature" Fischer Tropsch diesel.
The FTD produced by different suppliers operating the "low temperature" process is likely to be substantially similar in terms of emissions performance and composition.

With regards to emissions performance, Shell therefore recommends that these processes be considered separately. The unique properties of low temperature FTD can be simply defined in chemical or physical parameters, for example:
" A fuel derived from natural gas with a total aromatics content of < 1% m/m and cetane number of >65, produced by a Fischer-Tropsch (FT) process"

<u>Emissions Data from ANL</u>

Shell has extensively tested FTD in various laboratories of the Shell Group.
Please refer to Ref 1 (submitted separately) for an overview of analysis conducted by Shell.
Subject to their approval, Shell also intends to submit additional data generated by third parties to support the emissions benefits of FTD.

<u>Energy Limits in GTL processes</u>

Shell believes that the DOE should not set process energy use limited in its EPAct designation. Such limits would be very hard to monitor in practice. We also believe that GTL will be primarily applied to sources of gas for which no other practical method of commercialisation is available; even if a proportion of this energy is lost within the GTL process, that process would still allow the world to tap an otherwise unusable resource.

Balancing of Environmental Impacts

Shell believes that the DOE should balance the various environmental impacts of FTD to take an overall view. Indeed it is exceptional for any product to better than others across the entire spectrum of different environmental impacts.

NOx Emissions
Shell believes that reduction of NOx by 6-20% should be seen as substantial for the following reasons:

- PM benefits (Light-duty) on changing from low sulphur fuels (300-500ppm) to Ultra low sulphur fuels (<50ppm) are of the order of ~16%. This level of change is seen to be significantly beneficial.
- In the context of the available options to reduce diesel NOx, only hardware options are capable of yielding larger benefits. However these have drawbacks, NOx reduction by SCR (Selective Catalytic Reduction) would require a urea infrastructure. NOx absorber technology (favoured in the US) is showing technical promise, but is still expensive.
- This level of benefit can be achieved in very cost-effective manner (we discuss cost-effectiveness later in this document),
- Blends of FTD with standard diesel can also provide significant levels of emissions reduction. This allows relatively small volumes of FTD to improve the quality and emissions of a much larger pool of standard diesel (Shell discussed blends of FTD with standard diesel below).

Parameters for Aromatics, cetane, sulfur.
Shell's proposal for these is the same as for our proposed definition of low temperature FTD fuels above.
Low levels of aromatics might cause compatibility with vehicle engine fuel seals using older nitrile rubber material. However, there should be no problems observed with more modern seals made from fluorocarbon rubbers.

However, even in the case of the more vulnerable elastomer chemistry, provided there is careful inspection and maintenance procedure of vehicle fleets (e.g. replacing leaking seals) there should be no real issue with the introduction of this fuel. Such changes are very minor compared to the major changes usually needed to introduce other alternative fuels. Low aromatics fuels have been successfully introduced in other markets (e.g. Sweden, where both elastomer chemistries were in use) without major problems.

GHG Emissions

Shell believes that the DOE should designate all FTD meeting the defined parameters as alternative fuels irrespective of the specific situation of individual plants. This is because:

- In our view, there is little difference between life cycle GHG emissions from FTD and standard refinery diesel. Whilst Shell believes that the study of GHG emissions of different fuels by ANL is an important and valuable piece of work, the system boundaries used in this study (as acknowledged in the study itself) did not take account the fact that FT processes do not make heavy, undesirable refinery products such as coke or fuel oils. If these are added to the system under study, the GHG balance for FTD can, under certain assumptions, be favourable as compared to refinery diesel. Shell has commissioned a detailed study of this area (Ref 2), which is recommended for consideration by the DOE. Although this report was commissioned with the European market in mind, we expect a similar result for a US system. It should also be noted the GHG emissions within consuming countries (i.e. product usage, tank-to wheels GHG) such as the USA will definitely be lower with FTD than standard diesel, due to the former's higher mass calorific value and higher hydrogen content.

- In practical terms, it would be hard to monitor the GHG position of individual FT plants. Shell believes that in any case, few of these plants will have electricity or steam export or be based on flared natural gas.

Ecotoxicity and Biodegradability

Shell does have data in this area – see Reference (1).

Oxygenated compounds in GTL

Shell does not have any direct experience in this area and therefore cannot comment.

Required Additives

FTD may require the addition of anti-oxidant, lubricity and anti-static additives. These additives are needed for functioning in standard diesel engines, but not to give the superior emissions performance of FTD fuels. Additives such as lubricity improvers will in any case be needed with any conventional standard low sulfur diesel. Since the required additives impact on performance aspects of the fuel other than its environmental benefits, Shell does not believe that their use needs to be specified by the DOE. Fuels suppliers will recommend additives packages to customers and distributors as part of normal business practice (as currently happens for standard fuels).

Other Issues for Consideration

Shell recommends that two further areas are considered by the DOE:

Blends of FTD with Standard Diesel:

Blends of FTD as low as 20% can still significantly improve the emissions performance of standard diesel; in some engine systems, emissions benefits from blends are non-linear with the largest benefits gained from the addition of the initial volumes of FTD. Use of such blends can also greatly increase the effective availability of fuel (by a factor of 5 for a 20% blend) with a superior emissions performance. Furthermore, the need for a specially managed fuel introduction programme – required for 100% FTD in order to manage engine oil seal compatibility – is negated with FTD blends.

Shell recommends that the DOE class FT/Standard Diesel blends of > 20% SMDS as alternative fuels.

Cost Effectiveness:

One of the principal benefits of FTD is that the cost of introducing this fuel on a large scale will be considerably lower than most other alternative fuels. This arises from the fact that FTD will be used in standard diesel engines and will use the existing fuels infrastructure. Shell believes that cost-effectiveness should be a key component of government policy and has sponsored work to demonstrate the benefits of FTD in this area. This work will be available shortly, will be directly relevant to the US market, and is recommended as input for consideration by the DOE.

Domestic vs. Imported GTL products and Alternative Fuel Status

Shell believes that with respect to the key parameters that drive classification of a fuel as "alternative", imported GTL has credentials that are at least equal to domestically produced GTL. The emissions of GHG and local pollutants will be the same for both. As regards energy security, Shell believes that the US market generally will be short of natural gas and that any gas found on US territory will have a ready market in mainstream heating/power applications through the pipeline system. Domestically produced GTL will draw gas from a system where the US is already a net importer. Imported GTL, on the other, will use gas resources that would otherwise not have found ready commercialisation – i.e. they are a net addition to the energy supply options open to the US.

Note: References to "Shell" above refer to Shell International Gas, an affiliate of the Royal Dutch/Shell Group of Companies

References

1) An evaluation of Shell GTL Diesel – the Environmental Benefits. Clark, Virrels and Evans, Shell Global Solutions (US) Inc. 8th Diesel Engine Emissions Reduction Workshop, 25-29 Aug 2002, San Diego CA
2) Application of a life-cycle approach to assess the inputs and outputs and associated environmental impacts of production and use of distillates from a complex refinery and the SMDS route, PricewaterhouseCoopers, 2002